California Red-legged Frog Surveys in the Lower Pine Gulch Watershed Marin County, CA

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Introduction

The California red-legged frog (*Rana draytonii*) was once an abundant frog throughout much of California and is widely believed to have inspired Mark Twain's fabled story "The Celebrated Jumping Frog of Calaveras County." Now this frog is completely extirpated from the floor of the Central Valley (Fisher and Shaffer, 1996) and nearly gone in both the Sierra Nevada foothills and in the southern quarter of its range. In a few parts of the central Coast Range, there are still large, vigorous populations, some of which probably rival what was present 200 years ago (Fellers, 2005).

Some of the largest populations are at Point Reyes National Seashore (Marin County) where there are more than 120 breeding sites with a total adult population of several thousand frogs. Most of the breeding sites are artificial stock ponds constructed on lands that have been grazed by cattle for 150 years. There are good populations elsewhere in the San Francisco Bay area (especially Alameda and Contra Costa Counties) and in the coastal drainages from San Mateo County (just south of San Francisco) south to Santa Barbara County. One of the largest single populations consists of an estimated 350 adult frogs at Pescadero Marsh (San Mateo County) (Fellers, 2005).

The California red-legged frog was Federally listed as a Threatened species on June 24, 1996. The listing was necessary because the frog is absent from more than 70 percent of its original range and is threatened within its remaining range by a wide variety of human activities including urban encroachment, construction of reservoirs and water diversion, contaminants, agriculture, and livestock grazing (Draft Recovery Plan, January 2000). The role of non-native bullfrogs (*Rana catesbeiana*) is unclear. While bullfrogs have frequently been called a threat, or even a primary cause of the declines, there is almost no direct evidence that this is the case. Most reports of bullfrog impacts (e.g., Moyle, 1973) have been based merely on a correlation between the presence of bullfrogs and the lack of red-legged frogs. It is at least as likely

that non-native fish (e.g., bass, sunfish, catfish, mosquitofish) play a significant role in the decline of native ranid frogs (Hayes and Jennings, 1986).

California red-legged frogs need ponds and/or pools for breeding (December through March). At Point Reyes NS, stock ponds are the most commonly used breeding sites. There is much less information on non-breeding habitat requirements. While some frogs occupy breeding ponds all year, data from radiotagged red-legged frogs at Point Reyes and elsewhere suggest that riparian areas provide critically important habitat for many frogs, especially those that breed in non-permanent ponds or pools. It is likely that the riparian habitat is essential for the continued survival of red-legged frogs, particularly in dry years when breeding ponds are more likely to dry up.

A short-term study of California red-legged frogs along the lower reaches of Pine Gulch Creek and three adjacent ponds was initiated in 2006. The study was undertaken to evaluate the use of both the creek and pond habitat in that part of the drainage. This area was selected because of a proposal to dig or enlarge ponds on three adjacent farm properties that currently utilize water from Pine Gulch Creek. The proposed ponds would be used to store irrigation water for agricultural purposes. The findings from our work, along with data from previous surveys, are intended to aid in management decisions concerning habitat loss, preservation, and augmentation that may result from the proposed project.

Methods

Habitat Assessment

Three ponds (Weber Pond, Green Pond, Horse pasture Pond; Fig. 1) and the lower reaches of Pine Gulch Creek (Fig. 2) were visited during the day on 15 March 2006 to assess the extent of potential red-legged frog breeding and non-breeding habitat. We also visited the three proposed pond sites. These were designated New Weber Pond, New Green Pond, and Greenhouse Pond (Fig. 1).

Figure 1. Ponds and proposed ponds surveyed for California red-legged frogs (*Rana draytonii*) in the lower Pine Gulch Creek drainage, Marin County, California. Pond names in italics and mapped with a triangle represent proposed pond sites (New Green, Greenhouse, and New Weber Ponds). Non-italic names mapped with a circle represent existing ponds (Horse Pasture, Green, and Weber Ponds).

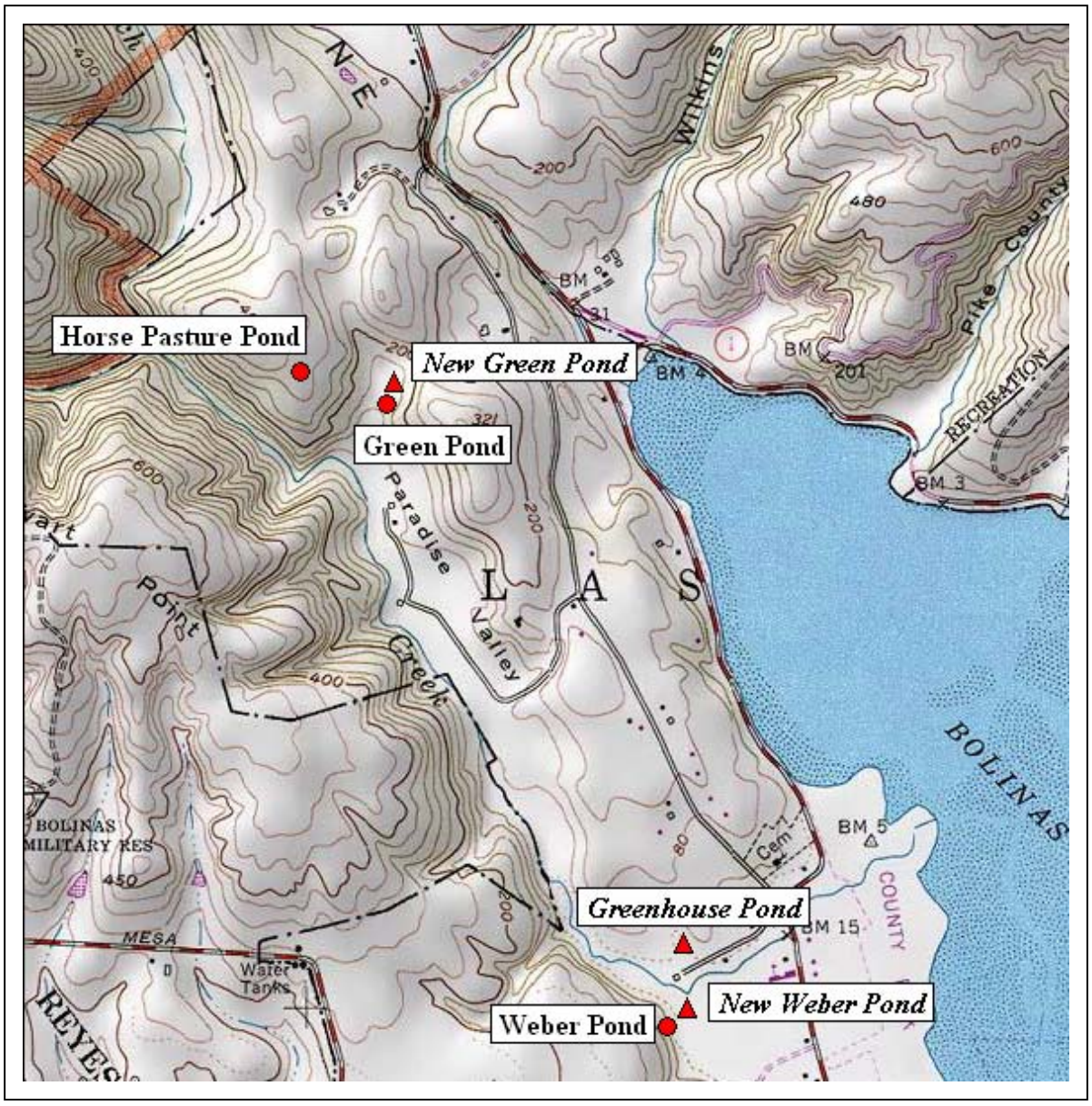
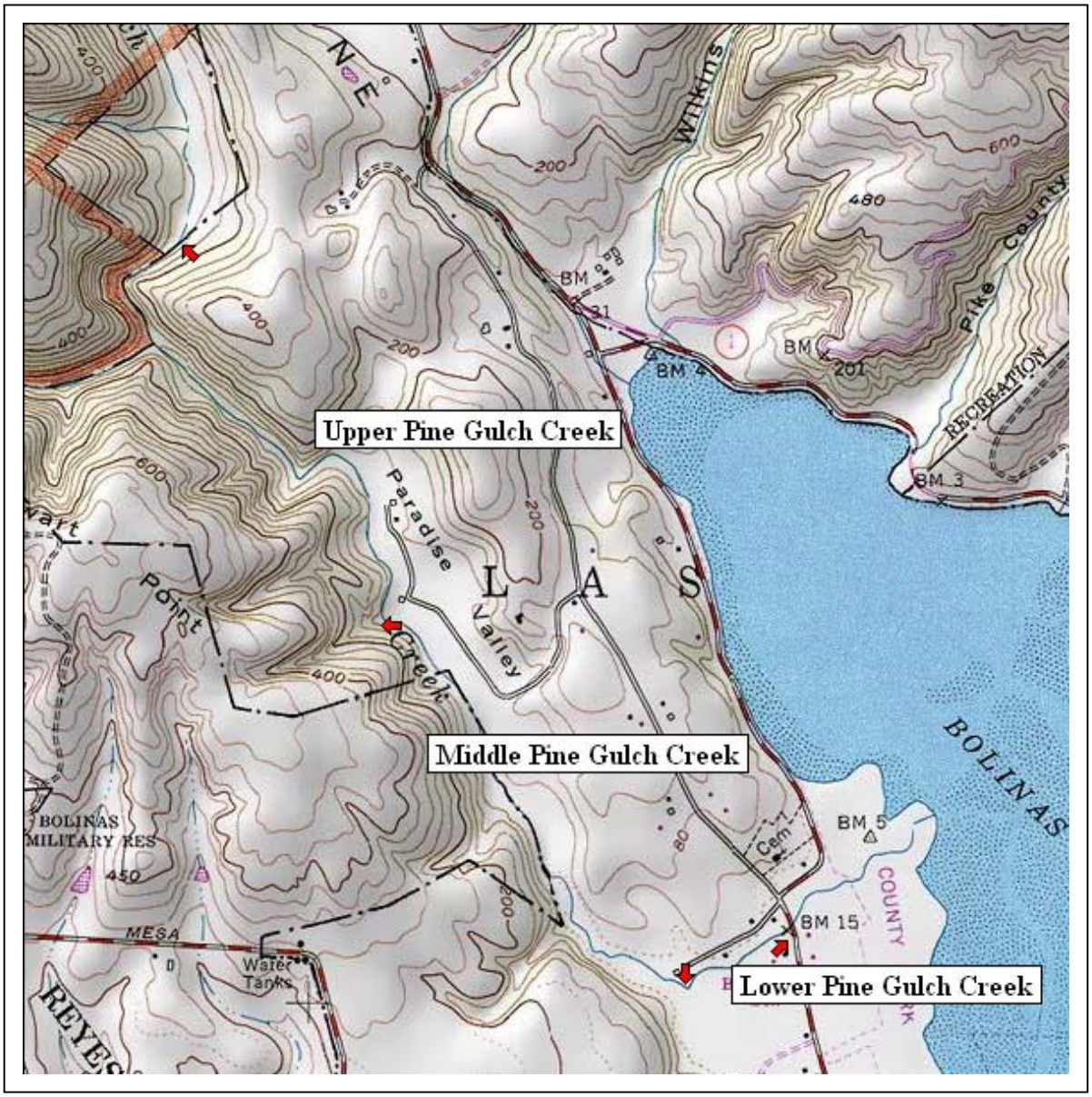


Figure 2. Pine Gulch Creek segments surveyed for California red-legged frogs (*Rana draytonii*) in the lower Pine Gulch Creek drainage, Marin County, California. The upstream and downstream boundaries for each segment are noted with a small red arrow.



Surveys for adult and subadult red-legged frogs were conducted during March, May, June, and July. All surveys took place after the breeding season had ended. Tadpole surveys were conducted in both June and July. Tadpole surveys at earlier dates are unlikely to detect frogs since the tadpoles are so small that they are often not captured.

All biologists conducting surveys for red-legged frogs (Gary Fellers, Patrick Kleeman, Michael Osbourn, and Jennifer Dhundale) were highly qualified field ecologists with extensive experience conducting frog surveys.

Survey Techniques

Surveys for red-legged frogs were conducted during the day for tadpoles and at night for adult frogs. Diurnal surveys were performed following the protocol of Fellers and Freel (1995): A Protocol for Surveying Aquatic Amphibians. In summary, diurnal surveys were conducted by slowly walking the perimeter of each pond while visually scanning the water for tadpoles and periodically dipping the water with a dipnet. These surveys were conducted 8 June and 12 July 2006, well after the breeding season, so no egg masses were present. No diurnal surveys were conducted along Pine Gulch Creek since the creek did not provide suitable breeding habitat for California red-legged frogs. Nocturnal surveys were conducted using spotlighting techniques described by Corben and Fellers (2001). Nocturnal surveys were conducted at each pond on three nights and along Pine Gulch Creek on two nights. These surveys were conducted by walking around the perimeter of the pond, or down the middle of the creek, stopping approximately every 5 m. At each stop, a 30-Watt sealed beam light and binoculars were used to look for the eye shine of red-legged frogs (Corben and Fellers, 2001). The binoculars were placed on the light, and the two were moved in tandem to scan nearby habitat (up to about 30 meters away). Unidentified eye shines were investigated by slowly approaching the animal until a positive identification could be made. If a positive identification was not possible, the frog was recorded as an unidentified species.

Results

Existing sites

California red-legged frogs were found along the lower reaches of Pine Gulch Creek (upstream from the Olema-Bolinas Road) and at both Weber Pond and Green Pond (Table 1, Fig. 1). Red-legged frogs were not found at the Horse Pasture Pond.

Green Pond was situated in a wet drainage that had a significant amount of high quality red-legged frog non-breeding habitat immediately to the north. This is important since that area is where one of the proposed new ponds would be constructed.

Green Pond had a substantial number of bullfrogs during each of our nocturnal surveys (14 - 25 adult bullfrogs). We never saw more than three California red-legged frogs during a site visit, but they were present during all nocturnal surveys. Interestingly, we found no signs of successful reproduction at Green Pond. At the time of our surveys (June and July), other ponds in west Marin County with populations of red-legged frogs had many recently transformed subadults that were readily observed around the perimeter of each pond. It is not clear whether the lack of these recently metamorphosed frogs indicates a lack of breeding, or whether there was no successful reproduction at Green Pond in 2006. We were also unable to find any bullfrog or red-legged frog tadpoles using a dipnet. This was somewhat surprising given the number of adult *Rana* seen during our surveys.

Weber Pond is much larger than Green Pond (110 m long versus 50 m long) and had more ranid frogs. We found 17 - 24 bullfrogs and 4 - 10 California red-legged frogs during our surveys. In addition, the mix of vegetation around the pond seemed especially favorable for frogs, especially the presence of cattail stands (*Typhus* sp.) and scattered willows (*Salix* sp.). At Weber Pond, as at Green Pond, we did not find any tadpoles or recently metamorphosed bullfrogs or red-legged frogs. It is not clear why.

We found only one adult, and one adult plus one subadult red-legged frog on our two nocturnal surveys of Pine Gulch Creek). Bullfrogs were more common, but not especially abundant. We found 3 - 8 bullfrogs on Upper Pine Gulch Creek, and 1 - 7 on the middle section (Fig 2. No *Rana* were seen along the much shorter lower segment that we only surveyed on one night. The red-legged frogs were all within the first 75 m upstream from the downstream end of the Middle Pine Gulch Creek segment. Perhaps this distribution is not surprising since that is the part of the creek nearest Weber Pond where we found the largest number of red-legged frogs.

Discussion

Our surveys documented the presence of California red-legged frogs at two ponds (Weber Pond and Green Pond) and in Pine Gulch Creek. Though we did not find any indication of reproduction, the limited time available for this work precluded winter surveys for eggs or late summer surveys for recently transformed subadults. We found large numbers of bullfrogs at both Green Pond and Weber Pond, but that was not surprising. We had previously conducted one survey at Weber Pond in December 2001 and found three adult red-legged frogs. No bullfrogs were seen at that time, but bullfrogs are more of a warm weather frog that is often not observed during mid-winter surveys.

Of the three new sites, construction in the vicinity of the Greenhouse Pond is least likely to have a negative impact on existing red-legged frog populations. The Greenhouse Pond is proposed for an area that is largely a grassland. There is a modest amount of potential non-breeding habitat on the east side of the site, but if that vegetation is not disturbed during construction, no habitat would be lost and the area could provide good refugia during the non-breeding season (December - March).

The New Green Pond site is more problematic. The proposed site is in the middle of an extensive area of potential non-breeding habitat for red-legged

frogs. It is not practical to survey that habitat with techniques similar to those we used at the ponds and along Pine Gulch Creek, but the habitat is similar to areas where we have found red-legged frogs (using radiotransmitters) in other parts of Marin County. Given the presence of red-legged frogs at the adjacent Green Pond, it is likely that non-breeding habitat would be lost with the construction of a new pond at this site. While a new pond might allow for a larger red-legged frog population, the presence of bullfrogs at Green Pond would facilitate their dispersal to the new site. U.S. FWS would need to be consulted to evaluate the benefits and impacts.

Weber Pond provides the best red-legged frog habitat within the current study area. Though there are bullfrogs present, the density is not as high as at Green Pond, and the number of red-legged frogs we observed is much larger than at Green Pond. In the cooler coastal climate of west Marin County, bullfrogs and red-legged frogs have been able to coexist and breed at several sites that we have followed for more than 20 years. Weber Pond may be such a site. Hence, we recommend that the current pond not be modified. If additional pond area is desired, an adjacent, non-connecting pond should be constructed.

Several aspects of red-legged frog biology should be taken into account when trying to establish new ponds. First, a mechanism for draining the pond should be incorporated into any new pond. Bullfrogs have tadpoles that require 14 - 16 months for development prior to metamorphosis. Hence, bullfrog tadpoles overwinter and tadpoles that started as eggs in the spring do not transform until sometime the following summer. Draining the pond each fall breaks the reproductive cycle and does not allow a breeding bullfrog population to become established. Though red-legged frog tadpoles occasionally overwinter (Fellers et al., 2001), this is not common.
Ponds can support non-native red-legged frog predators that can have a serious impact on native frogs. Most notable are mosquitofish, sunfish, and bass. It is highly recommended that any newly constructed ponds do not have

any fish planted in them. If fish do become established, draining the pond can eliminate this problem along with any bullfrog tadpoles.

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Table 1. Amphibians and reptiles found as part of California red-legged frog (*Rana draytonii*) surveys in the lower Pine Gulch Creek drainage, Marin County, California.

date	site	locality	begin time	species	adult	subadult	larvae	eggs	site length	UTM east	UTM north	observer
5/25/2006	P-158B	Upper Pine Gulch Creek	21:15	Pacific treefrog	0	1	0	0	1960	525193	4199265	PK
5/25/2006	P-158B	Upper Pine Gulch Creek	21:15	Bullfrog	3	0	0	0	1960	525193	4199265	PK
6/28/2006	P-158B	Upper Pine Gulch Creek	21:35	Pacific treefrog	1	0	0	0	1960	525193	4199265	PK
6/28/2006	P-158B	Upper Pine Gulch Creek	21:35	Bullfrog	0	6	0	0	1960	525193	4199265	PK
6/28/2006	P-158B	Upper Pine Gulch Creek	21:35	*Rana* sp.	0	2	0	0	1960	525193	4199265	PK
5/25/2006	P-158C	Middle Pine Gulch Creek	21:00	Bullfrog	1	0	0	0	1980	526814	4196513	GF
5/25/2006	P-158C	Middle Pine Gulch Creek	21:00	CA red-legged frog	1	0	0	0	1980	526814	4196513	GF
6/28/2006	P-158C	Middle Pine Gulch Creek	21:20	Bullfrog	2	5	0	0	1980	526814	4196513	GF
6/28/2006	P-158C	Middle Pine Gulch Creek	21:20	CA red-legged frog	1	1	0	0	1980	526814	4196513	GF
6/28/2006	P-158C	Middle Pine Gulch Creek	21:20	*Rana* sp.	1	0	0	0	1980	526814	4196513	GF
5/31/2006	P-158D	Lower Pine Gulch Creek	22:52	-	0	0	0	0	320	527088	4196648	PK, GF
3/15/2006	P-539	Weber Pond	20:19	Pacific treefrog	6	0	0	0	110	526742	4196348	PK, GF
3/15/2006	P-539	Weber Pond	20:19	Bullfrog	17	0	0	0	110	526742	4196348	PK, GF
3/15/2006	P-539	Weber Pond	20:19	CA red-legged frog	4	1	0	0	110	526742	4196348	PK, GF
3/15/2006	P-539	Weber Pond	20:19	*Rana* sp.	6	0	0	0	110	526742	4196348	PK, GF
5/31/2006	P-539	Weber Pond	22:07	Pacific treefrog	6	0	0	0	110	526742	4196348	PK, GF, SH
5/31/2006	P-539	Weber Pond	22:07	Bullfrog	24	0	0	0	110	526742	4196348	PK, GF, SH
5/31/2006	P-539	Weber Pond	22:07	CA red-legged frog	10	0	0	0	110	526742	4196348	PK, GF, SH
5/31/2006	P-539	Weber Pond	22:07	*Rana* sp.	10	0	0	0	110	526742	4196348	PK, GF, SH
6/8/2006	P-539	Weber Pond	15:46	Pacific pond turtle	1	0	0	0	96	526742	4196348	JD, MO
6/8/2006	P-539	Weber Pond	15:46	Bullfrog	6	0	0	0	96	526742	4196348	JD, MO
6/8/2006	P-539	Weber Pond	15:46	*Rana* sp.	2	0	0	0	96	526742	4196348	JD, MO
7/6/2006	P-539	Weber Pond	22:34	Bullfrog	18	0	0	0	110	526742	4196348	GF

7/6/2006	P-539	Weber Pond	22:34	CA red-legged frog	8	0	0	0	110	526742	4196348	GF
7/6/2006	P-539	Weber Pond	22:34	*Rana* sp.	5	0	0	0	110	526742	4196348	GF
7/12/2006	P-539	Weber Pond	11:16	Bullfrog	3	0	0	0	96	526742	4196348	PK
7/12/2006	P-539	Weber Pond	11:16	CA red-legged frog	1	0	0	0	96	526742	4196348	PK
7/12/2006	P-539	Weber Pond	11:16	*Rana* sp.	5	0	0	0	96	526742	4196348	PK
7/12/2006	P-539	Weber Pond	11:16	Rough-skinned newt	0	0	1	0	96	526742	4196348	PK
3/15/2006	P-547	Horse Pasture Pond	19:02	Pacific treefrog	3	0	0	0	18	525612	4198329	PK, GF
3/15/2006	P-547	Horse Pasture Pond	19:02	Bullfrog	4	0	0	0	18	525612	4198329	PK, GF
5/31/2006	P-547	Horse Pasture Pond	21:22	Bullfrog	4	0	0	0	12	525612	4198329	PK
6/8/2006	P-547	Horse Pasture Pond	13:41	Pacific treefrog	0	28	72	0	10	525612	4198329	JD, MO
6/8/2006	P-547	Horse Pasture Pond	13:41	Rough-skinned newt	0	0	44	0	10	525612	4198329	JD, MO
6/8/2006	P-547	Horse Pasture Pond	13:41	California newt	0	0	26	0	10	525612	4198329	JD, MO
3/15/2006	P-649	Green Pond	19:31	Pacific treefrog	6	0	0	0	30	525872	4198221	PK, GF
3/15/2006	P-649	Green Pond	19:31	Bullfrog	20	0	0	0	30	525872	4198221	PK, GF
3/15/2006	P-649	Green Pond	19:31	CA red-legged frog	1	0	0	0	30	525872	4198221	PK, GF
3/15/2006	P-649	Green Pond	19:31	*Rana* sp.	9	0	0	0	30	525872	4198221	PK, GF
5/31/2006	P-649	Green Pond	21:20	Pacific treefrog	1	0	0	0	30	525872	4198221	GF, SH
5/31/2006	P-649	Green Pond	21:20	Bullfrog	25	0	0	0	30	525872	4198221	GF, SH
5/31/2006	P-649	Green Pond	21:20	CA red-legged frog	2	0	0	0	30	525872	4198221	GF, SH
6/8/2006	P-649	Green Pond	14:21	Pacific treefrog	0	1	25	0	49	525872	4198221	JD, MO
6/8/2006	P-649	Green Pond	14:21	Bullfrog	1	1	0	0	49	525872	4198221	JD, MO
6/8/2006	P-649	Green Pond	14:21	*Rana* sp.	2	0	0	0	49	525872	4198221	JD, MO
6/8/2006	P-649	Green Pond	14:21	California newt	0	0	8	0	49	525872	4198221	JD, MO
7/6/2006	P-649	Green Pond	21:55	Bullfrog	14	0	0	0	30	525872	4198221	GF
7/6/2006	P-649	Green Pond	21:55	CA red-legged frog	3	0	0	0	30	525872	4198221	GF
7/12/2006	P-649	Green Pond	10:16	Pacific treefrog	0	3	2	0	49	525872	4198221	PK
7/12/2006	P-649	Green Pond	10:16	Bullfrog	2	0	0	0	49	525872	4198221	PK

Observers: GF = Gary Fellers, PK = Patrick Kleeman, JD = Jen Dhundale, MO = Michael Osbourn, SH = Shannon Holbrook.